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(54)Title: CATALYST CONVERTER

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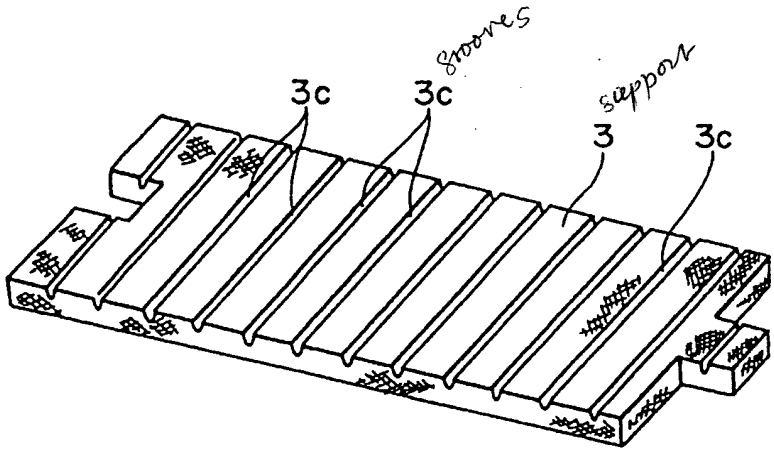
(57) Abstract

A catalyst converter in which a monolith is stably fixed by a specific monolith support and from which no exhaust gas leaks at all through the outer periphery of the monolith. The monolith support (3) comprises a compressed crystalline alumina fiber mat and an organic binder, and has a large number of grooves (3c) orthogonal to the winding direction in the surface thereof. The monolith support (3) follows up changes in the clearance between the outer peripheral surface of the monolith and the inner surface of the casing resulting from the temperature change of the monolith (1) and the casing (2) after the organic binder is thermally decomposed, supports the monolith (1) by its restoring elastic force, and exhibits strong adhesion to the outer peripheral surface of the monolith (1) thanks to the grooves (3c).



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Catalyst Converter

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A catalyst converter in which a monolith is stably fixed by a specific monolithic support and from which there are no exhaust gas leaks at all through the outer periphery of the monolith. The monolith support (3) comprises a compressed crystalline alumina fiber mat and an organic binder, and has a large number of grooves (3c) that are orthogonal to the winding direction in the surface thereof. The monolith support (3) follows changes in the clearance between the outer peripheral surface of the monolith and the inner surface of the casing resulting from the temperature change of the monolith (1) and the casing (2) after the organic fiber is thermally decomposed, supports the monolith (1) by its restoring elastic force, and exhibits strong adhesion to the outer peripheral surface of the monolith (1) thanks to the grooves (3c).

Detailed description of the invention

Catalyst Converter

Technological sphere

The present invention is an invention about a catalyst converter, and in more details, it is an invention about a catalyst converter that is mainly used in automobiles, and it is a catalyst converter where the monolith is fixed by a specific monolith supporting support and also, the leaks of exhaust gas through the outer periphery of the monolith are reliably eliminated.

Previous background

The catalyst converters, as it is well known, are devices where the contained in the exhaust gas from the internal burning mechanisms carbon monoxide, hydrocarbons, nitrogen oxides etc., toxic components are removed by using a precious metal catalyst. In the reported in the Japanese Patent Application Laid Open Number Hei-Sei 9-946, the catalyst converter technology according to the presented in Figures 3 ~ 5, has been disclosed where the so-called one body type catalyst, where the catalyst metal is supported in a cylindrically shaped monolith support body (here below called "monolith") that has been provided with a large number of exhaust gas pathways, and it has been possible to design for durability properties and a small form factor.

In the case of the catalyst converter that has been reported according to the above described document, it has a structure that is formed from the monolith (1), that is formed with a cylindrical shape and also that supports the catalyst that is used for the purification of the exhaust gas, and the manufactured from metal casing (2), that encloses the monolith (1) and also, whose two ends are connected to the exhaust gas conducting pipe, and the monolith support (3), that is wrapped around the monolith (1) and is placed in the space between the above described monolith and the casing (2).

Regarding the monolith (1), in order to decrease the resistance at the time when the exhaust gas is passing through and also in order to increase the catalytic efficiency, usually, it is made to have a honey comb structure that ensures an even larger surface area in the path of the flow of the exhaust gas.

Present Invention

In the case of the catalyst converter according to the present invention, it is characterized by the fact that it is a catalyst converter that has a structure that is formed from the monolith, that is formed with a cylindrical shape and also that supports the catalyst that is used for the purification of the exhaust gas, and the manufactured from metal casing, that encloses the monolith and also, whose two ends are connected to the exhaust gas conducting pipe, and the monolith support material, that is wrapped around the monolith and is placed in the space between the above described monolith and the casing; where the above described monolith protective material has a structure that is formed from a crystalline alumina fiber mat that is compressed to the thickness and an organic binder material that is homogeneously incorporated into the above described alumina mat and that also is eliminated as it is thermally decomposed, and not only that but also, on the front surface of the above described monolith support material that is the side that is contacting the above described monolith, a large number of grooves are provided that are placed in a direction that is orthogonal to the direction of the wrapping of the above described support material.

In the case of the above described catalyst converter, the monolith protecting

material is a material where the contained in it organic binder material is eliminated by a thermal degradation and this support material follows the change in the clearance between the outer peripheral surface of the monolith and the inner surface of the casing resulting from the temperature change of the monolith and the casing and the monolith is supported by its restoring elastic force. Also, in the case of the monolith support material that is provided with the specific grooves, in the state where it is wrapped around the monolith there are no wrinkles generated, and relative to the outer peripheral surface of the monolith high it exhibits strong adhesion properties.

Simple explanation of the figures

Figure 1 represents a three dimensional diagram showing the monolith support material used in the catalyst converter according to the present invention. Figure 2 is a front view diagram showing the wrapped state of the monolith support material in the catalyst converter according to the present invention, and the monolith in the figure is a monolith manufactured from ceramics that is one example of the monoliths. Figure 3 is a assembled state three dimensional view diagram showing the usual structure of the catalyst converter, and the monolith shown in the figure shows a monolith manufactured from metal (gold) as one example. Figure 4 is a three dimensional view diagram showing the usual wrapped outline of the monolith support material relative to the monolith. Figure 5 is a front view diagram showing the wrapped state of the monolith support material in the catalyst converter according to the previous technology.

Best practical implementation conditions for the present invention

The best practical implementation conditions for the present invention will be explained based on the diagrams. Moreover, in the explanation of the best practical implementation conditions for the present inventions, Figure 3 and Figure 4 are also used in order to explain the previous technology background.

In the case of the catalyst converter according to the present invention, as it is shown according to the presented in Figure 3, it has a structure that is formed from the monolith (1), that is formed with a cylindrical shape and also that supports the catalyst that is used for the purification of the exhaust gas, and the manufactured from metal casing (2), that encloses the monolith (1) and also, whose two ends are connected to the exhaust gas conducting pipe, and the monolith support (3), that is wrapped around the monolith (1) and is placed in the space between the above described monolith and the casing (2).

As the monolith (1), besides monoliths that have a structure formed from ceramics that has as its main component codeirrite etc., it is also possible to use monoliths that have a structure formed from metal foil materials etc. Especially, the ferrite type stainless steel that has as its main body components Fe, Cr, Al or Si, is a material that is preferred for the formation of the structure of the metal manufactured

monolith, because it has good attuning to the coat material and the catalyst at the time of the supporting of the catalyst, and not only because of that, but also, it is preferred because of the fact that the thermal change after the catalyst support is relatively small.In the monolith (1), usually, Pt, Rh etc., precious metal layers are supported and by that a function as a catalyst is imparted.

Regarding the casing (2), it is provided with 2 part clam shell structure that is combined in one body as the two parts, the casing part (2a), that forms the structure of the upper half of the above described casing and the casing part (2b), that forms the structure of the lower half part, are combined. The casing part (2a) and the casing part (2b) each, have the flange parts (21a) and (21b), and these flange parts (21a) and (21b), function as the bonding surface at the time of the joining of the casing part (2a) and the casing part (2b). Also, on both edge parts of the casing part (2b) that is on one side, the connection openings (4) and (5) are provided that are used for the connection to the exhaust gas transport pipe. In Figure 3, the symbols (22a) and (22b) represent the bolt openings for fixing onto the automobile body etc., of the automobile. Moreover, as the metal manufactured casing, it is also possible to advantageously use the casing that has a stuffing structure where the monolith that has been formed in advance into a cylindrical shape has been inserted.

the primary characteristic according to the present invention is the advantageous use of the specific monolith support material (3). Namely, the monolith support (3) has a structure that is formed from a compressed crystalline alumina fiber mat (here below called in short "mat"), and an organic binder that is homogeneously impregnated into that mat and that is eliminated by a thermal decomposition. And the above described mat shows a specific restorative force, at the time when it is compressed to the thickness corresponding to the clearance between the outer peripheral surface of the monolith (1) and the inner surface of the casing (2), and there is no destruction of the monolith (1) and also, it sufficiently demonstrates supporting results relative to the above described monolith.

In more details, the above described mat, in the state where it is compressed to the thickness corresponding to the clearance between the outer peripheral surface of the monolith (1) and the inner surface of the casing (2), has a restorative force preferably in the range of 0.1 ~ 10.0 kgf/cm2, and especially preferably, in the range of 0.1 ~ 8.0 kgf/cm2. Regarding the expected restoring force, in the case when the monolith (1) is made from ceramics material, it is made to be in the range of 0.5 ~ 10.0 kgf/cm2, and preferably, it is made to be in the range of 0.5 ~ 8.0 kgf/cm2, and in the case when the monolith (1) is made from gold, it is made to be in the range of 0.1 ~ 4.0 kgf/cm2.

The above described restoring force appears after the elimination of the organic binder that is homogeneously impregnated into the mat, by a thermal decomposition. The mat restoring force corresponds to the force (compression force) that is necessary in order to compress the mat to the thickness corresponding to the clearance between the outer peripheral surface of the monolith (1) and the inner

surface of the casing (2). Consequently, according to the present invention, by the compression force at the time of the formation of the mat, the above described restoring force is defined.

Namely, it is defined by the thickness, the elastic properties, of the mat, the clearance between the outer peripheral surface of the monolith (1) and the casing (2), its thermal change amount, the gas seal properties and the strength at break of the monolith (1), however, it is determined so that it becomes the compression force corresponding to the above described restoring force at the time of the compression to a thickness corresponding to the clearance between the outer peripheral surface of the monolith (1) and the casing (2).

Namely, regarding the mat that is used as the substrate material for the monolith support (3), it is said that it is a conglomerate material obtained from alumina fibers that are almost homogeneously laminated as layers in the direction of the thickness, and it also includes the materials that are called blankets or blocks. As the alumina fibers, usually fibers that have a fiber diameter that is in the range of 1 ~ 50 microns, and a fiber length that is in the range of 0.5 ~ 500 mm, are used, however, from the point of view of the restoring force and the shape sustaining properties, it is especially preferred if the alumina fibers used have a fiber diameter that is in the range of 3 ~ 8 microns and a fiber length that is in the range of 0.5 ~ 300 mm.

As the composition of the above described alumina fibers, it is an alumina - silica type crystalline material short fiber, and besides the alumina that has a silica content of no more than 5 weight %, namely, the high alumina material that contains at least 95 weight % or more alumina, there is also the usual material where the alumina is in the range of 70 ~ 95 weight %, and also, where the remaining structure is formed from silica. Especially, in the case of the mullite composition fibers where the alumina content is in the range of 72 ~ 85 weight %, it is a material that has excellent high temperature stability properties and elastic strength properties, and it is the preferred alumina fiber material.

Regarding the crystalline alumina fiber, compared to the same alumina- silica type material that is non-crystalline (or amorphous), it has excellent thermal resistance properties, and similarly to the ceramic material fibers, it is a material that has an extremely little thermal deterioration like softening compression etc., and because of that, in the case when it is made into a compressed mat, it has ample elastic properties. Namely, it is stated that the mat has high supporting properties at low bulk density , and also that its thermal deformation is small. Consequently, because of the difference in the thermal expansion between the monolith (1) and the casing (2) that is manufactured from metal, the clearance between the monolith (1) and the casing (2) is changed, and even in the case when its bulk density is increased, there is no abrupt change of the supporting pressure relative to the monolith (1).

As long as the organic binder is a material can support the compressed mat thickness under normal temperature conditions, and after it is eliminated by a thermal decomposition a restoration of the thickness of the above described mat is obtained, there are no particular limitations and such material can be used. However, it is necessary to prevent the use of organic binder materials that even at temperatures above the temperature of use are not decomposed, and especially, it is necessary to avoid the materials that by hinder the flexibility properties and the restored surface compression properties of the mat that is obtained by the impregnation of this organic binder, and it is necessary to avoid the use of organic binder materials that have such properties that they facilitate the destruction of the monolith (1). As the organic binder material, it is possible to use different types of rubber materials, water soluble macromolecular compounds, thermoplastic resin materials, thermosetting resin materials, etc.

As the above described rubber type materials, there are the synthetic rubber materials: copolymer material obtained from ethyl acrylate and chloroethyl vinyl ether, copolymer material obtained from n-butyl acrylate and acrylonitrile, copolymer material obtained from ethyl acrylate and acrylonitrile, etc., acrylic rubber materials; nitrile rubber obtained from a copolymer material from butadiene and acrylonitrile, etc., butadiene rubber materials, etc.; as the water soluble organic macromolecular compounds, there are the carboxy methyl cellulose, polyvinyl alcohol, etc. As the thermoplastic resin materials, there are the acrylic type resins that are acrylic acid, acrylic acid ester, acrylamide, acrylonitrile, methacrylic acid, methacrylic acid esters, etc., homopolymers and copolymers; acrylonitrile - styrene copolymer materials; acrylonitrile - butadiene - styrene copolymer materials, etc. Also, as the thermosetting resin materials, there are the bis phenol type epoxy resins, the Novolac type epoxy resin etc.

The water solution, water type emulsion, latex, organic solvent solution of the effective component of the above described organic binder material (here below called for short "binder solution"), are commercially available, and these binder solutions, in the state as they are or diluted with a solvent, can be used, and because of that a relatively inexpensive price of their usage is obtained. Moreover, it is possible to use one type of these binders and also depending on the requirements it is possible to use a mixture of two materials.

Among the above described organic binder materials, it is a preferred option if at least one type of materials is selected from the group of the acrylic rubber, nitrile rubber, carboxy methyl cellulose, polyvinyl alcohol and acrylic rubbers besides the acrylic resin materials, and especially, among the acrylic rubber materials, the nitrile rubbers, etc., synthetic rubber materials, the rubbers that have flexibility properties are especially effective.

There are no specific limitations regarding the content of the organic binder material, and it is determined by the type and the shape of the fiber material that forms the structure of the mat, the absolute thickness of the mat, the thickness and the restoring force as a molded formed material containing the organic binder and prior to the assembly with the

casing (2). Regarding the binder content, usually it is a good option if relative to 100 weight parts of the alumina fiber the effective component of the organic binder material is made to be within the range of 3 ~ 30 weight parts. In the case when the content of the organic binder material is made to be less than 3 weight parts, it is a case where it is not possible to support the thickness as a formed material by the mat regeneration, and in the case when the contained amount exceeds 30 weight parts, the cost is increased and beside that the flexibility properties of the molded material are lost. From this point of view, it is preferred that the above described organic binder proportion is in the range of 5 ~ 20 weight parts.

The most important characteristic of the present invention is the fact that the monolith support material (3) is shaped into a specific shape. Namely, on the front surface of the monolith support (3) that is the side that comes in contact with the monolith (1), a large number of grooves (3c) is provided that are orthogonal to the direction of the wrapping of the above described monolith support material. Regarding the cross sectional surface of the grooves (3c), usually, they are shaped into a V letter shape or U letter shape. And at the time when by using such a structure the monolith support material (3) is wrapped onto the monolith (1), it is possible to eliminate the generation of wrinkles at the inner peripheral surface of the monolith support material (3), and it is possible to even more reliably prevent the leakage of the exhaust gases.

Also, regarding the monolith support material (3), in order to increase even further the adhesive properties relative to the monolith (1), the depth of the grooves (3c) are 1/30 ~ ½ of the thickness of the monolith support (3), and also, the width (the maximum width of the opening of the groove) of the grooves (3c) is preferred to be in the range of 1/30 ~ ½ of the width of the monolith support (3). Especially, regarding the monolith support (3), it is preferred that the arrangement pitch of the grooves (3c) is in the range of 1/20 ~ 2 of the radius of the curvature of the monolith (1). Moreover, the curvature radius of the monolith (1) is usually in the range of 10 ~ 80 mm.

The monolith support (3) is manufactured by (a) the technological process of the impregnation of the organic binder material into the mat, (b) the technological process where the mat that has been impregnated by the organic binder solution is compressed in the thickness direction, © the technological process where in the compressed state as it is, the solvent component of the organic binder solution is eliminated. Then, regarding the grooves (3c) that are on the front surface of the monolith support (3), they are formed as in the technological process (b), a compression is conducted where on one side of the mat there is a smooth shaping plate and on the other side of the mat there is a shaping plate that is provided with peaks that correspond to the grooves (3c), or as after the technological process ©, the formed (molded) material is subjected to a groove cutting technological process. Also, in order to eliminate the deviation or variation at the time of the assembly, as it is shown according to the presented in Figure 1, parts that are making mutual contact as a gear assembly, at the time of the wrapping, are provided by a cross sectional cutting technological process on both edge parts in the direction of the wrapping.

The monolith support (3) that is obtained by the above described technological processes, is wrapped around the outer peripheral surface of the monolith (1) as it is shown according to Figure 4. In this case, on the surface that corresponds to the inner periphery side of the monolith support (3), a large number of grooves (3c) are provided, and because of that, extremely simply and also reliably, the monolith support material (3) can be wrapped. Also, in the case when the monolith support (3) has been wrapped, as it is shown according to the presented in Figure 2, the difference in the length of the outer periphery and the inner periphery that is generated because of the thickness of the monolith support material (3), is compensated by the large number of grooves (3c), and because of that it is possible to accomplish the wrapping so that there are no wrinkles relative to the monolith (3) and so that it is in a tightly adhered state. Then, the monolith (1) that has been wrapped by the monolith support material (3) is housed into the casing (2), as shown according to the presented in Figure 3.

Regarding the catalyst converter that is shown as an example in Figure 3, the two part structure casing (2) is advantageously used where the joining is conducted by using the flange part (21a) of the casing part (2a) and the flange part (21b) of the casing material (2b) as the joint surfaces. In the case when the monolith (1) is housed in the casing (2), it is not necessary that the monolith support material (3) has the same thickness relative to the clearance that is formed between the outer peripheral surface of the monolith (1) and the inner surface of the casing (2), and even if it is slightly thicker material it is possible to be assembled. However, in the case when it is too thick, or in the case when the slipping relative to the casing (2) is poor, one part of the fibers of the monolith support material (3) are coming out and protruding from the bonding surface of the flange parts (21a) and (21b), and the bonding becomes impossible, etc., other poor conditions are generated, and because of that its thickness is defined in the range of 1.0 ~ 2.0 times the above described clearance. Regarding the upper limit of this defined value, preferably, it is made to be 1.7 times, and especially preferably, it is made to be 1.6 times.

As it is shown in the figures, in the case of the catalyst converter according to the present invention t is preferred that the monolith (1) is directly supported by the monolith support material (3), that is formed from a crystalline alumina fiber mat. And namely, in the case of the structure where the monolith (1) is directly supported by the above described specific monolith support material (3), it is possible to demonstrate appropriate tightening force relative to the monolith (1) and also there is no fear of destruction of the monolith (1).

Regarding the catalyst converter according to the present invention, mainly, it is applied in the exhaust gas pipes of automobiles. And regarding the catalyst converter according to the present invention, at the time when the high temperature exhaust gases that are coming out from the internal burning mechanisms are passing through, the temperature of the monolith (1), the casing (2) and the monolith support material (3) is increased and for the monolith support material (3), the organic binder material that has been impregnated

in the mat is eliminated by a thermal destruction. and its thickness is restored and by that. the monolith (1) is fixed.

Namely. by the passing through of the exhaust gases. in the case when the monolith (1) is manufactured from ceramics. the manufactured from metal casing (2). compared to the monolith (1). has a higher thermal expansion. and because of that the clearance between the outer peripheral surface of the monolith (1) and the inner surface of the casing (2) becomes large. On the other hand. in the case when as in the above described. the monolith (1) is manufactured from metal. compared to the manufactured from metal casing (2). the thermal expansion of the monolith 91) becomes large. and because of that the clearance between the outer peripheral surface of the monolith (1) and the inner surface of the casing (2) becomes narrow. Relative to that. in the case of the above described specific monolith support (3). it follows the changes in the clearance between the outer peripheral surface of the monolith (1) and the inner surface of the casing (2). based on the temperature change of the monolith (1) and the casing (2). and because of that the monolith (1) is directly and also elastically fixed inside the casing (2).

If we are to say that in other words. the monolith support material (3). has a structure that is formed as in a compressed mat an organic binder material is homogeneously impregnated. and at the time of the assembly. because of the bonding strength of the organic binder material. the thickness restoring properties are suppressed. and because of that it is possible to be easily fixed and placed. And also. at the time of the operation the organic binder material is removed by the thermal decomposition and its (of the support) thickness restoring elastic force is now demonstrated. and because of that it is possible to fix the monolith (1) extremely stably.

And not only that. but also. because of the fact that the monolith support material (3) is provided with a large number of grooves (3c) on the front surface that is at the side of the monolith (1). in the state when the support is wrapped around the monolith (1). there is no generation of wrinkles and high adhesive properties relative to the outer peripheral surface of the monolith (1) are demonstrated. As a result from that. it is possible to completely close the clearance between the outer peripheral surface of the monolith (1) and the inner surface of the casing (2) and it is possible to eliminate even more reliably the leakage of the exhaust gases through the outer surface of the monolith (1).

Possibilities for advantageous application in the industry

As it has been described here above. in the case of the catalyst converter according to the present invention. because of the use of a specific monolith support material where by the thermal decomposition of the organic binder material there is a restoration in the direction of the thickness. it is possible to fix the monolith easily and also stably. And not only that but also. because of the fact that a large number of grooves are provided on the front surface of the monolith support material. that is the side contacting the monolith. at the time of the assembly. it is possibly to easily wrap the monolith support material on the monolith. and then. it is possible to even further increase the adhesive properties of the

monolith support material relative to the monolith, and because of that, it is possible to even more reliably eliminate the leakage of exhaust gases from the clearance between the outer peripheral surface of the monolith and the inner surface of the casing.

Consequently, the catalyst converter according to the present invention can be used as a device for the even more reliable elimination of the contained in the exhaust gases from the internal burning mechanisms, carbon monoxide, hydrocarbons, nitrogen oxides etc., toxic components.

Range of the Claims of the Invention

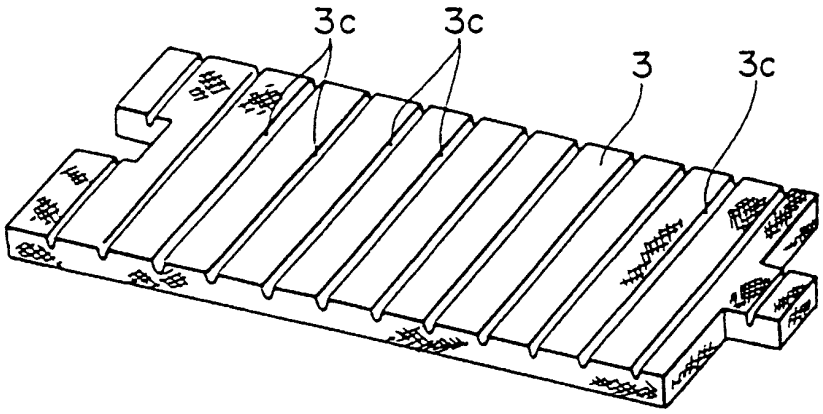
1. Catalyst converter characterized by the fact that it is a catalyst converter that has a structure formed from a monolith (1), that is shaped in a cylindrical shape and that supports the catalyst used for the purification of the exhaust gases, a manufactured from metal casing (2), that houses the monolith (1) and is also connected to the exhaust gas transporting pipes, and a monolith support (3), that is wrapped around the monolith (1) and that is placed in the gap between the above monolith and the casing (2); where the monolith support (3) has a structure that is formed from a crystalline alumina fiber mat that is compressed in the direction of the thickness and an organic binder material that is homogeneously impregnated into the above alumina mat and also that is removed by a thermal decomposition, and not only that but also, on the surface of the monolith support (3), that is the side that makes contact with the monolith (1), a large number of grooves (3c) is provided that are orthogonal to the direction of the wrapping of the above monolith material.

2. Catalyst converter according to the above described Claim 1 where the depth of the grooves (3c) is in the range of 1/30 ~ ½ of the thickness of the monolith support material (3), and the width of the grooves (3c) is in the range of 1/30 ~ ½ of the thickness of the monolith support material (3).

3. Catalyst converter according to Claim 1 or Claim 2 where the arrangement pitch of the grooves (3c) is in the range of 1/20 ~ 2 of the radius of the curvature of the monolith (1).

4. Catalyst converter according to any of the above reported Claims 1 ~ 3 where the alumina fiber mat that forms the structure of the monolith support material has a restoring force that is in the range of 0.1 ~ 10.0 kgf/cm2, at the time when it is in a compressed state that has a thickness corresponding to the clearance between the outer peripheral surface of the monolith (1) and the inner surface of the casing (2).

図 1



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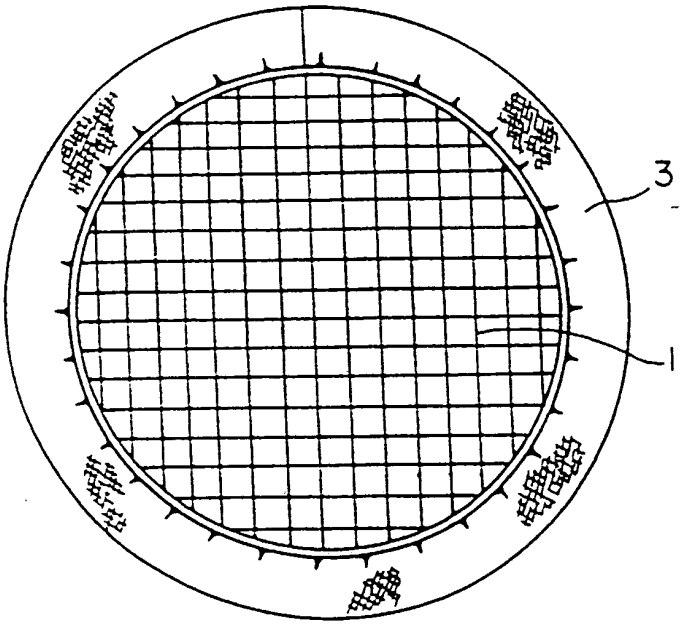

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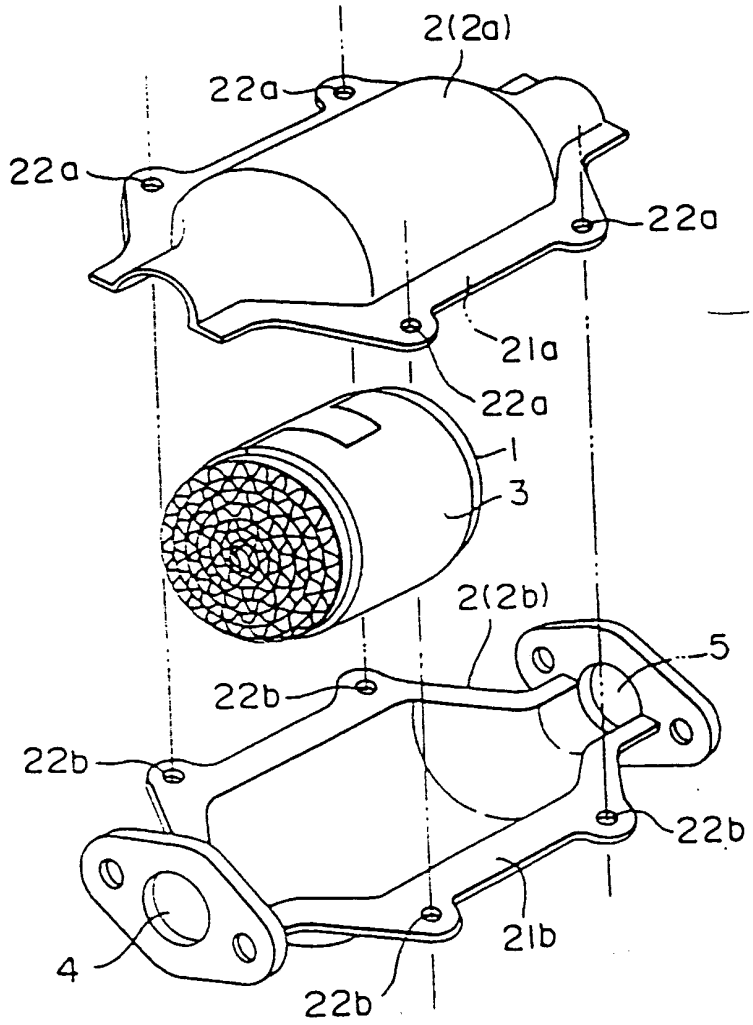


図 4

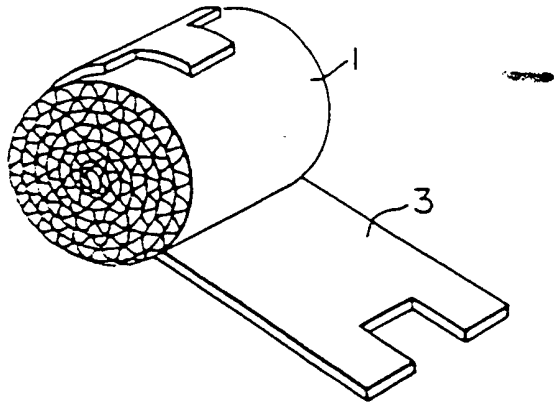
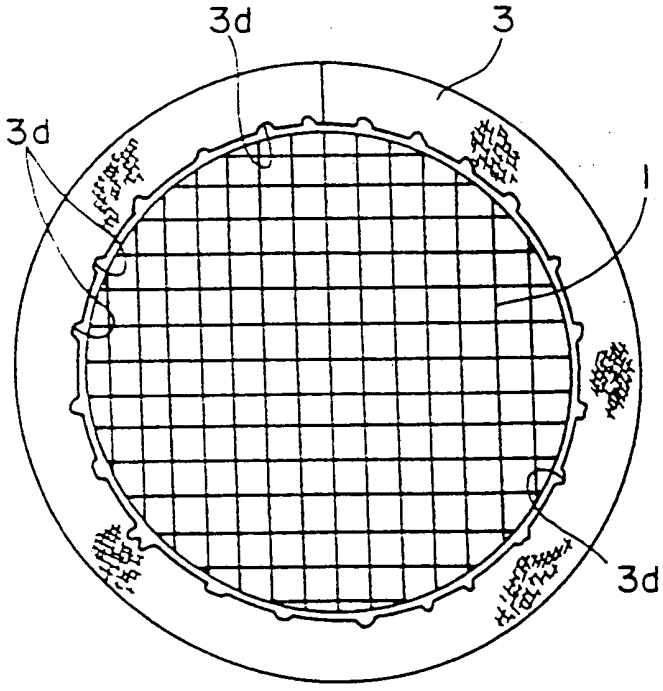


図 5



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TITLE: Catalyst converter - in which a monolith is stably fixed by a specific
monolith support

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PATENT-ASSIGNEE: MITSUBISHI CHEM CORP[MITU]

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ABSTRACTED-PUB-NO: WO 9845583A
BASIC-ABSTRACT: A catalyst converter in which a monolith is stably fixed by a
specific monolith support and from which no exhaust gas leaks at all through

the outer periphery of the monolith. The monolith support (3) comprises a compressed crystalline alumina fiber mat and an organic binder, and has a large number of grooves (3c) orthogonal to the winding direction in the surface thereof. The monolith support (3) follows up changes in the clearance between the outer peripheral surface of the monolith and the inner surface of the casing resulting from the temperature change of the monolith (1) and the casing (2) after the organic binder is thermally decomposed, supports the monolith (1) by its restoring elastic force, and exhibits strong adhesion to the outer peripheral surface of the monolith (1) thanks to the grooves (3c).

CHOSEN-DRAWING: Dwg.1/5

TITLE-TERMS:
CATALYST CONVERTER MONOLITHIC STABILISED FIX SPECIFIC MONOLITHIC SUPPORT

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